

# **Executive Summary**

*Prepared by the U.S. Department of Energy  
Office of Biological and Environmental Research*

On June 23, 2001, the U.S. Department of Energy (DOE) held a workshop of biotechnology leaders to examine potential roles for biotechnology on mitigation of greenhouse gases and their effects on climate. The workshop participants discussed a wide range of possible biotechnology solutions to reduce atmospheric concentrations of greenhouse gases, the use of biomass for fuel production, and the use of biological processes to make cleaner fuels with higher energy content. This Executive Summary was prepared by DOE staff in response to the workshop summary, prepared by workshop cochairs Drs. Venter and Nealson, to link the range of biotechnology solutions discussed to DOE mission needs.

## **Solutions for Carbon Sequestration Using Microbes and Plants**

- Plants can be modified so that they take up more carbon from the atmosphere and retain more of this carbon in an inaccessible form when they die and decompose.
- The mix of microbes found in complex microbial communities in soil can be altered to enhance the long-term retention of soil carbon. Generally, more carbon in soil also has broad positive benefits for soil fertility and water retention.
- The ability of the ocean's microbial communities to remove carbon from the atmosphere and deposit it permanently in the deep ocean can be enhanced. But first, this possible solution must be proved environmentally acceptable. Advanced biotechnology techniques can help make this determination.

## **Use of Biomass for Fuel Production**

- Plants can be modified to
  - grow places they wouldn't normally grow
  - grow faster and more efficiently
  - be more easily harvested
  - contain material more easily converted to clean energy
- Microbes can be used as sources of biomass for energy because they can be readily modified and will grow in industrial environments and/or inhospitable natural environments.

## **Use of Biological Processes to Make Cleaner Fuels with Higher Energy Content**

- Microbes carry out some chemical processes better than comparable solutions designed by people. Thus, microbes or their products can be used to convert sunlight, hydrocarbons, or biomass to useful energy products without the production of greenhouse gases such as CO<sub>2</sub>. These types of biological conversions can operate under a wider range of conditions than traditional industrial approaches.